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See image for Certificate of Correction

TITLE: Method for inspecting filled
state of via-holes filled
with fillers and apparatus
for carrying out the method

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INVENTOR-INFORMATION:

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ABSTRACT:

A method for inspecting the filled state of a plurality of via-holes which pass through a non-conductive circuit board and are filled with a conductive substance and an apparatus for carrying out the method are disclosed.

The surface of the circuit board is illuminated in two directions to generate shadows depending on the concave or convex state of the fillers in a plurality of via-holes. An optical image of the illuminated surface of the circuit board is detected. Each edge of the two shadow areas, which exist in the detected optical image and are generated in one via-hole by light irradiation in two directions, is detected. Whether the filler in this one via-hole is in the concave state or convex state is identified according to the mutual position relationship of the detected edges.

The length of each shadow area is detected, and whether the concave state or convex state of the filler is within a predetermined allowance is decided according to the detection results. The area of the image of the filler is detected according to differences between the brightness of the board surface or of the via-hole wall and the brightness of the filler in the via-hole in the detected optical image, and whether the filler is lacking or not is decided according to the detection result.

18 Claims, 30 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 16

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Detailed Description Text - DETX (9):

In the apparatus with the configuration mentioned above, a detected image signal is inputted to the shading correction circuit 17, 18, or 19 to correct uneven illumination or uneven sensitivity of line sensor 13a, 13b, or 13c. The shading correction circuits 17, 18, and 19 are, for example similar to the one indicated in Japanese Patent Application Laid-Open No. 58-153328. The shading-corrected image signal is binarized by the binarizing circuit 20, 21, 22, or 23 according to the binarizing threshold value VH.sub.2, VH.sub.1, or VH.sub.3. The binarizing threshold values can be determined as follows. From the image signal detected as shown in FIG. 5(a), the frequency distribution is determined as shown in FIG. 5(b). A signal level H.sub.max indicating the brightness of the green sheet surface and a signal level H.sub.min indicating the brightness of the filler are determined from the distribution curve. The binarizing levels VH.sub.1 and VH.sub.2, which are threshold values, are determined by executing operations according to those output data. These operations are performed by histogram generation circuits 24, 25, and 26 and the microcomputer 27 shown in FIG. 1. These binarizing levels may be determined with a green sheet to be inspected before starting the automatic inspection.